

NASA's Soil Moisture Active and Passive (SMAP) Mission

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ABSTRACT

The Soil Moisture Active-Passive (SMAP) Mission is one of the first Earth observation satellites being formulated by NASA in response to the 2007 National Research Council's Decadal Survey. SMAP will make global measurements of soil moisture at the Earth's land surface and its freeze-thaw state. These measurements will allow significantly improved estimates of water, energy and carbon transfers between the land and atmosphere. Soil moisture measurements are also of great importance in assessing flooding and monitoring drought. Knowledge gained from SMAP observations can help mitigate these natural hazards, resulting in potentially great economic and social benefits. SMAP observations of soil moisture and freeze/thaw timing over the boreal latitudes will also reduce a major uncertainty in quantifying the global carbon balance and help to resolve an apparent missing carbon sink over land. The SMAP mission concept will utilize an L-band radar and radiometer sharing a rotating 6-meter mesh reflector antenna flying in a 680 km polar orbit with an 8-day exact ground track repeat aboard a 3-axis stabilized spacecraft to provide high-resolution and high-accuracy global maps of soil moisture and freeze/thaw state every two to three days. In addition, the SMAP project will use these surface observations with advanced modeling and data assimilation to provide estimates of deeper root-zone soil moisture and net ecosystem exchange of carbon.

SMAP recently completed its Phase A Mission Concept Study Phase for NASA and transitioned into Phase B (Formulation and Detailed Design). A number of significant accomplishments occurred during this initial phase of mission development. The SMAP project held several open meetings to solicit community feedback on possible science algorithms, prepared preliminary draft Algorithm Theoretical Basis Documents (ATBDs) for each mission science product, and established a prototype algorithm testbed to enable testing and evaluation of the performance of candidate algorithms. SMAP conducted an Applications Workshop in September 2009 to coordinate with potential application users interested in the mission data. A draft Applications Plan describing the Project's planned outreach to potential applications users has been prepared and will be updated during Phase B. SMAP made a significant evaluation of the potential terrestrial radio frequency interference (RFI) source environment and established radiometer and radar flight hardware and ground processing mitigation approaches. SMAP finalized its science orbit and orbit injection approach to optimize launch mass and prepared launch and commissioning scenarios and timeline. A science data communications approach was developed to maximize available science data volume to improve science margins while maintaining moderately short data product latencies to support many potential applications using existing ground assets and with minimum impact to the flight system. SMAP developed rigid multi-body and flexible body dynamics and control models and system designs for the 6-meter rotating instrument reflector-boom assembly (RBA) and flight system to confirm pointing and control performance, and devised strategies to efficiently implement on-orbit balancing if needed. Industry partners were selected for the spin mechanism assembly (SMA) and RBA. Preliminary designs for the radar and radiometer were initiated, including constructing breadboards of key assemblies.

SMAP is entering Phase B with a target launch date of late 2014.

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Keywords: Soil moisture, global water cycle, microwave remote sensing, projects